



## MULTI-STANDARD OPTICAL DISK READING METHOD HAVING DISTINCTION PROCESS

### Background of the Invention

#### 1. Field of the Invention :

This invention relates to optical data storage systems. More specifically, this invention relates to an optical reading method for an optical data reproducing system which is able to reproduce encoded data at different pit density on varied types of optical disk format.

#### 2. Description of the prior Art :

Initialized by the vast increase in information that needs to be processed, optical data storage system have become very important system particularly because of their high storage density per area. Most of the recent optical information storage systems rotating single optical disk are used on which the information is digitally stored in concentric circular tracks in an ordered, predefined manner to allow chronological fast reading and fast random access to desired pits of data.

At present, varied type of optical disk systems are provided, for example, compact disk (CD) system, Mini-Disk (MD) system and multi-layered optical disk for digital video disk (DVD) system. Each of these optical disk format is fabricated dependent upon different standard. And thickness or pit density of the each optical disk is different from one and another. An optical reading system is needed which is able to reproduce the encoded data from any types of optical disk format.

#### 3. Summary of the Invention :

The present invention has for its object to provide a multi-standard optical disk reading system having distinction process, which can read encoded pits on varied types of optical disk format.

The object of the present invention can be achieved by an optical disk reading method having distinction process, the steps comprising: to read a total of contents (TOC) data in a read-in region of an optical disk before starting reproduction process, to read any encoded pits until

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identifying a type of the optical disk format if the TOC data is not encoded on the optical disk, to collate the TOC data or any processed data with stored data in a memory, to obtain data about standard of the optical disk from the memory, to set up modulation of first stage position of a focusing lens or to select a focusing lens, to set up modulation of a tracking servo, and to start reproducing data on the optical disk.

In an optical disk such as a compact disk (CD), a Mini-Disk (MD) and a digital video disk (DVD), a TOC data is encoded in the read-in region of the disk. And at first, the TOC data is reproduced by a pick-up head. The TOC data includes total number of portions of information such as music, movie or computer program, and time consuming data for reproduction. Also, the TOC data of some types of optical disk contains address of each of the information and reproduction time of each of the information.

In addition, the TOC data also represents the standard of the optical disk, such as pit density, total data capacity and reproducing speed. Such data about the standard of the optical disk can be encoded as TOC data. Otherwise, the standard of the optical disk is identified by reproducing the TOC data which is encoded in accordance with the standard. The data about the standard of the optical disk is better to be contained in the TOC data in order to start reproducing process faster. However even the data about the standard is not contained in TOC data, the standard of the optical disk can be identified by processing TOC data or certain amount of pits to certify the total number of data encoded surfaces, the pit density and track pitch. After making sure the standard of the optical disk, each movement of a focusing lens servo, a tracking servo or a spindle servo is determined to reproduce the data on the optical disk. The focusing lens servo is modulated to focus laser beam onto encoded pit on the optical disk by moving the focusing lens or changing the focusing lens. If the optical disk has more than one data surface, the focusing lens servo has to be modulated to read each of the data surface. The tracking servo and the spindle servo are modulated in order to trace the encoded pit lane on the optical disk with the focal point.

For a fuller understanding of the nature and advantages of the present invention reference should be made to the following detailed description taken in conjunction with the accompanying drawings.

#### 4. Brief Description of the Drawings

Fig 1 shows block diagram of an example of an optical reading apparatus to which the present invention can be applied;

Fig 2 is a flowchart for a description of a multi-standard optical disk reading method of the present invention.

#### 5. Detailed Description of the Preferred Embodiment

Embodiments of the present invention will be explained with reference to the drawings.

Fig 1 is a block diagram of an example of an optical reading apparatus to which the optical disk reading methods of the present invention can be applied. An optical disk 10 represent one of optical disk formats among a compact disk (CD), a Mini-Disk (MD), a digital video disk (DVD) or the other. The optical disk 10 is mounted on and secured by a turntable 12 to be rotated by a spindle motor 14. Encoded pit on the optical disk 10 is read by a pickup 16 which includes a laser diode, a focusing lens, a focusing lens actuator, a tracking actuator and a photo-detector. The output signal from the pickup 16 is transmitted to a focusing servo circuit 18, a tracking servo circuit 20 and an RF amplifier 22. According to focusing error signal, the focusing servo circuit 18 modulates the focusing lens actuator to move the focusing lens. And according to tracking error signal, the tracking servo circuit 20 modulates the tracking actuator to move the pickup 16. A clock generator 24 produces a demodulating reproduction clock signal which is generated to a spindle servo circuit 26. The spindle servo circuit 26 modulates the spindle motor 14 in order to track linear velocity of the optical disk 10.

The output signal applied to the RF amplifier 22 from the pickup 16, is transmitted to an address decoder 28. Then the decoded signal is processed by a system controller 30. The system controller 30 has a

signal processor which recognizes pit density of the optical disk 10, accompanying with a ROM (Read Only Memory) 32. The signal from the photo-detector in the pickup 16 is amplified by the RF amplifier 22, and the amplified signal is decoded by an address decoder 28 to be collated by the system controller 30 with the ROM 32 which stores data about pit density standards. After the standard of the optical disk 10 is identified, a servo control circuit 34 determines position or selection of the focusing lens by modulating the focusing servo circuit 18, and the tracking servo circuit 20 is modulated to move the pickup 16 in order to trace the pit lane which is fabricated in accordance with the pit density standard.

The output signal of the RF amplifier 22 in the clock generator 24 together with the reproduction clock signal is applied to the address decoder 28 including a frame synchronizing circuit. The reproduction clock signal is converted by the address decoder 28, and the converted clock signal is transmitted to the servo control circuit 34 which modulates or stabilizes the spindle motor 14 accompanying with the clock generator 24 and the spindle servo circuit 26. The demodulation data signal of the address decoder 28 is transmitted to a decoder 36 which also controls a memory controller 38. The decoded data signal is stored in a RAM (Random Access Memory) 40 for a shock proof function or a continuous data processing function with multi data surface optical disk. The decoded data signal by the decoder 36 or the stored data signal by the RAM 40 is processed by a data processor 42, and the processed data signal is converted from digital signal to analog signal by a D/A (digital to analog) converter 44. Then, after the data signal is amplified by a amplifier 46, the data reproduction is completed.

Each of a control signal of the servo control circuit 34, the address decoder 28, the decoder 36 and the memory controller 38 is supplied from a system controller 30. The system controller 30 is operated by an operation signal from a key operating unit 48 which transmits all operating signal of a user or an operator. The system controller 48 also controls a display unit 50 to show the data reproducing status to the operator.

Fig 2 shows a flowchart of an operation processing in the system controller 30 in Fig 1. When a power switch is turned on and the optical disk is mounted on the turntable, the system controller operates the pickup to access to the TOC data by modulating the servo control circuit, tracking servo circuit and focusing servo circuit (step 1 : S1). In step 2 (S2), the system controller recognizes whether the TOC data is encoded on the optical disk or not. When the TOC data is encoded on the optical disk, the TOC data is read with an operation of the system controller (S3). Then the read TOC data is collated with stored data in the RAM to identify type of the optical disk format along with its total number of data layers and pit density (S4). In the step 5 (S5), the system controller determines whether type of the optical disk along with its total number of data layers and its pit density standard is identified or not. In case that the TOC data is not encoded on the optical disk in step 2 (S2) and the case that type of the optical disk is not identified in step 5 (S5), the system controller operates the pickup to read any data on the optical disk by modulating the servo control circuit, tracking servo circuit and the focusing servo circuit (S6). In step 7 (S7), the system controller operates the decoder to process the data. Then the processed data is collated with stored data in the RAM to identify type of the optical disk format along with its total number of data layers and its pit density (S8). In the step 9 (S9), the system controller determines whether type of the optical disk along with its total number of data layers and its pit density standard is identified or not. In case that type of the optical disk is not identified in step 9 (S9), the process has to go back to step 6 (S6). When type of the optical disk is identified in step 5 (S5) or step 9 (S9), the system controller determines each set up of the all servo circuit dependent upon the recognized type of the optical disk (S10). In step 10 (S10), the system controller determines each modulation such as the focusing servo circuit, tracking servo circuit or spindle servo circuit. In the step 10 (S10), the focusing servo circuit modulates the focusing lens actuator to move the focusing lens or change the focusing lens, the tracking servo circuit modulates the tracking actuator to move the pickup, and the spindle servo circuit modulates the spindle motor to track linear velocity of the optical disk. Also in step 10 (S10), the system controller can determine which decoding circuit is used to process the data dependent upon the type of the optical disk. When a data reproduction switch is turned on in step 11

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(S11), the system controller starts reproducing data on the optical disk in step 12 (S12). When a data reproduction switch is not turned on in step 11 (S11), the data reproducing has to be waited.

Although the invention has been particularly shown and described, it is contemplated that various changes and modification may be made without departing from the scope of the invention as set forth in the following claims.